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IS 10960-2 (1984): Grain sizes for diamond or cubic boron nitride, Part 2: Method of test of macro grits [PGD 9: Abrasives]

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IS : 10960 (Part 2) - 1984

(Reaffirmed 2005)

Indian Standard

GRAIN SIZES FOR DIAMOND OR CUBIC BORON NITRIDE

PART 2 METHOD OF TEST OF MACRO GRITS

1. Scope — Covers the method for testing macro grits (grain size) of diamond (natural or synthetic) or cubic boron nitride for judging its conformity to the requirements specified in IS : 10960 (Part 1) - 1984 'Grain sizes for diamond or cubic boron nitride : Part 1 Designation and grain size distribution'.

Note — For simplification, reference is made throughout this standard to 'Diamond' grains, but all indications also apply to cubic boron nitride.

2. General Requirements for Testing Equipments

2.1 *Test Sieving Machine* — The test sieving machine used shall have a speed of 290 rev/min and shall give 156 vertical strokes per minute. The sieves set shall be able to rotate freely during these two movements. The test machine shall be provided with a base plate on which the sieves rest. The lid shall be provided with an opening for a cork plug. The drop height between cork plug and the tapper shall be 38 ± 6 mm.

2.2 *Test Sieves* — For the testing of the abrasive grain sizes four sieves with different mesh openings, which together with a bottom tray and a lid constitute a sieve set, are used.

2.2.1 *Coarse sieves* — Standard 200 mm diameter brass frame 25 mm high, nested with metal wire mesh of mesh opening 1180 to 425 µm (*Nom*) conforming to IS : 460 (Part 1) - 1978 'Specification for test sieves: Part 1 Wire cloth test sieves', shall be used.

2.2.2 *Fine sieves* — Electro-formed sieves of mesh opening 455 to 41 µm (*Nom*) with a brass or stainless steel frame of 200 or 75 mm diameter and 25 mm height.

The electro-formed sieves shall have the apertures of the sizes given in Table 1.

TABLE 1 APERTURES ON ELECTRO-FORMED SIEVES

Aperture Size µm	Tolerances on Aperture Size µm	Ruling Lines per Centimetre	Aperture Size µm	Tolerances on Aperture Size µm	Ruling Lines per Centimetre
455	±3	16·4	127	±2	49·2
384		18·7	116		49·2
360		20·3	107		59·1
322	±3	21·9	97	±2	65·6
302		24·6	90		65·6
271		26·2	85		71·6
255	±3	26·2	75	±2	78·7
227		30·3	65		78·7
213		30·3	57		87·5
197	±3	35·8	49	±2	98·4
181		35·8	41		98·4
165		39·4			
151		43·7			
139		46·3			

Note — The openings of electro-formed sieves differ from the nominal mesh opening of the wire sieves (*see* Explanatory Note).

Electro-formed fine sieves shall have a supporting grid with 2.2 lines per centimetre, bonded to the top surface of the sieve to prevent diamond grains sliding over the smooth top surface, which would considerably reduce sieving efficiency.

Adopted 18 July 1984

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Abrasives Sectional Committee, EDC 13; Industrial Diamond and Super Abrasives Subcommittee, EDC 13 : 4 [Ref : Doc : EDC 13 (3967)]

2.3 *Sample Splitter* — shall be used for taking a representative sample from the batch of the abrasive grains submitted for the test.

2.4 *Balance for Weighing the Diamonds* — Accuracy as follows:

±0·01 g using sieves of 200 mm diameter, and
±0·001 g using sieves of 75 mm diameter.

2.5 *Timer* (*Time Switch*) — of an accuracy of ±15 s over a period of 15 min.

3. Testing Procedure

3.1 *Atmospheric Conditions for Testing of Grain Size*

Relative humidity	45 to 55 percent
Temperature	20 to 25°C

3.2 *Sampling of Grains* — The quantity of the sample to be tested is mixed and divided to a representative sample by means of a sample splitter. The resulting sample shall then be spread out on a stainless steel pan where it shall be allowed to acclimatize for 30 min at the atmospheric conditions specified in **3.1**. The sample is then weighed using balance of accuracy specified in **2.4** and it shall be within the values given in Table 2 and Table 3 respectively.

3.3 *Preparation for Sieving* — The prescribed set of sieves shall be composed in the order of the mesh openings, that is, coarsest sieve on top and the finest sieve at the bottom. Pour the test sample on to the top sieve and place a lid over the latter. After placing the lid, the entire set of sieves is placed in the sieving machine. To facilitate rotation during the sieving cycle, a clearance of 3 mm shall be maintained between the lid and the holding stirrup of the sieving machine. This is done in order to prevent the incomplete sieving and hence erratic results.

An adaptor shall be used with 75-mm diameter sieves.

3.4 *Test Sieving Procedure* — Set the timer controlling the sieving machine for 15 min and switch on the machine. At the completion of the cycle, remove the set of sieves from the machine. Beginning with the top (coarset) sieve, empty the oversize grains onto a clean piece of glossy paper by gently striking the frame.

This process shall be repeated with each subsequent sieve, taking care that they are not damaged.

In the case of coarse sieves, the lower side is brushed with a soft wire brush in order to remove the particles adhering to the sieve. Fine sieves shall not be brushed, but cleaned periodically by ultrasonic methods.

4. Evaluation of the Test Results

4.1 *Weighing of the Sieve Fractions* — The residue of diamond grains and quantity passed from each sieve shall be transferred and weighed in the balance pan to the accuracy specified in **2.4.**

If the sum of the quantities of all sieve fractions, that is, residue plus quantities passed is less than 99 percent of the original quantity of the sample tested the entire test shall be repeated with a fresh sample.

4.2 *Calculation of Test Results* — Calculate percentage diamond grains retained on each sieve and the bottom pan, relative to the cumulative final mass of the sample. The determined percentages of diamond grains shall be within the values specified in Table 2 and Table 3.

Example : Consider an abrasive grain size designated D 151 for the test.

At least 99·9 percent of the test sample shall pass through sieve 1 with a mesh opening of 227 µm. The entire test sample may pass through sieve 2 (upper test sieve) with a mesh opening of 165 µm. A maximum residue of 10 percent is permitted.

On sieve 3 (lower test sieve) with mesh opening 127 µm, the entire passed quantity may remain. The permissible residue on sieve 3 shall be atleast 87 percent of the total test sample. The permissible maximum passing through quantity is 10 percent. If the residue on sieve 3 (lower test sieve) is more than 87 percent, but at the same time the passing through quantity is more than 10 percent (because a correspondingly greater quantity has fallen through sieve 1 and 2), the test sample does not conform with the standard. From sieve 4 with a mesh of 90 µm, not more than 2 percent of the total test sample shall pass through.

TABLE 2 GRAIN SIZE DISTRIBUTION WHEN TESTING WITH WIRE MESH SIEVES

(*Clauses* 3.2 *and* 4.2)

Range Grade	IS Grit Designation		Test Sample Quantity g		Sieve 1	Sieve 2		Sieve 3			Sieve 4
					99·9 percent Through Sieve (Oversize Limiting Sieve)	Upper Test Sieve		Lower Test Sieve			2 percent Through Sieve (Undersize Limiting Sieve)
						Aperture Size	*Max.* Oversize	Aperture Size	*Min.* Oversize	*Max.* Undersize	
	Diamond	Boron Nitride	From	Upto	µm	µm	percent	µm	percent	percent	µm
Narrow	D 1 181	B 1 181	80	120	1 700	1 180	8	1 000	90	8	710
	D 1 001	B 1 001			1 400	1 000		850			600
	D 851	B 851			1 180	850		710			500
	D 711	B 711	80	120	1 000	710	8	600	90	8	425
	D 601	B 601			850	600		500			355
	D 501	B 501			710	500		425			300
Wide	D 1 182	B 1 182	80	120	1 700	1 180	8	850	90	8	600
	D 852	B 852			1 180	850		600			425
	D 602	B 602			850	600		425			300

1 µm = 10^{-6} *m*.

TABLE 3 GRAIN SIZE DISTRIBUTION WHEN TESTING WITH ELECTRO-FORMED SIEVES

(*Clauses* 3.2 *and* 4.2)

Range Grade	IS Grit Designation		Test Sample Quantity g		Sieve 1	Sieve 2		Sieve 3			Sieve 4
					99·9 percent Through Sieve (Oversize Limiting Sieve)	Upper Test Sieve		Lower Test Sieve			2 percent Through Sieve (Undersize Limiting Sieve)
						Aperture Size	*Max.* Oversize	Aperture Size	*Min.* Oversize	*Max.* Undersize	
	Diamond	Boron Nitride	From	Up to	µm	µm	percent	µm	percent	percent	µm
Narrow	D 426	B 426	80	120	600*	455	8	360	90	8	255
	D 356	B 356			500*	384		302			213
	D 301	B 301			455	322		255			181
	D 251	B 251			384	271		213			151
	D 213	B 213			322	227		181			127
	D 181	B 181	40	60	271	197	10	151	87	10	107
	D 151	B 151			227	165		127			90
	D 126	B 126			197	139		107			75
	D 107	B 107	40	60	165	116	11	90	85	11	65
	D 91	B 91			139	97		75			57
	D 76	B 76	20	30	116	85		65			49
	D 64	B 64			97	75		57			41
	D 54	B 54	20	30	85	65	15	49	80	15	—
	D 46	B 46			75	57		41			
Wide	D 427	B 427	80	120	600*	455	8	302	90	8	213
	D 252	B 252			384	271		181			127

1 µm = 10^{-6} *m*.

*Do not use electro-formed sieves. Use wire sieves of these aperture sizes.

EXPLANATORY NOTE

This part of the standard covers the method of test for the macro grain sizes (grits), whereas IS : 10960 (Part 1)-1984 covers the grit designation and grain size distribution of narrow as well as wide range grades of diamond or cubic boron nitride abrasive grains.

For the testing of macro grits two different types of sieves are used. The bigger grains are tested with wire mesh sieves whereas the finer ones are tested with electro-formed sieves. This standard is in alignment with DIN 848 (Part 2)-1980 'Grain sizes of diamond or cubic boron nitride — Method of test of macrogrits' issued by Deutsche Institut für Normung, which is also in agreement with ISO 6106-1979 issued by International Organization for Standardization (ISO).

The reason for choosing the apertures of electro-formed sieves are as follow:

From comparison of the results of sieving diamond grit with woven wire and electro-formed sieves, it has been found that the aperture of the matching electro-formed sieve has to be larger than the nominal size of the woven wire sieve probably because of the different geometry of the sieve. This difference was established by a calibration procedure.

It has also been found that the results of sieving a given grit with different sets of certified standard wire sieves are variable, due to the unavoidable but permitted variation in the actual apertures of standard woven wire sieves.

In addition to differences between sieves, every real wire sieve behaves as if it has two effective aperture sizes. Under specified sieving conditions, the larger of these determines the lower limit of oversize which can never pass, the smaller determines the upper limit of undersize which will always pass. Particles of intermediate size may or may not pass, depending on how and where they move on the sieve surface. Thus the sieve behaves differently — as though it has different apertures — according to whether it is being used to hold back oversize or screen undersize.

Corresponding to each wire sieve size, therefore, there are two electro-formed sieves as specified:

a) one, the upper control sieve, is slightly larger than the calibrated median size of equivalent woven wire sieves;

b) the other, the lower control sieve, is slightly smaller than the calibrated median size of equivalent woven wire sieves.

However, because of the geometric effect mentioned above, the minimum size electro-formed sieve is usually larger than the nominal wire sieve aperture size.

The apertures in Table 1 take all these factors into account.

In testing diamond grains for percentage-on-size, two electro-formed sieves are used. For example, when testing grain designated D 107 for percentage-on-size, the 116 μm sieve used is the larger of the pair of sieves calibrated to correspond to the 106 mesh wire sieve, and the 90 μm sieve used corresponds to the smaller of the sieve pair calibrated to correspond to the 90 mesh wire sieve.

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